Simulation of runaway electrons with MHD modes

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Dynamics of runaway electrons in the presence of macroscopic MHD instabilities is studied. Generation of massive runaway beam currents has become a crucial issue for the development of reliable disruption mitigation schemes in ITER. A difficulty arises in a large gap of the avalanche growth gain between present tokamaks and ITER, which prevents us from a straightforward extrapolation of the experimental data towards disruptions with 10MA-order plasma currents. Therefore – in addition to experimental demonstration of runaway mitigation – the development of numerical simulations increases its importance. To clarify possible effects of MHD modes on runaway electron generation, we have applied a nonlinear reduced fluid model [1] for long- term simulations of runaway generation scenario in a post-disruption plasma. In a plasma unstable to resistive kink modes, the coupling between MHD modes, runaway electrons, and electric fields becomes important. It is shown that seed electrons can be enhanced with inductive electric fields and the final runaway beam profile develops to be consistent with the resistive MHD stability [2]. For exploring the possibility of runaway suppression, magnetic and orbit stochasticity is suggested to cause radially global transport of runaway electrons [3].

[1] A. Matsuyama, N. Aiba, M. Yagi, submitted.

[2] A. Matsuyama, N. Aiba, M. Yagi, 26th IAEA Fusion Energy Conference, 17-22 October 2016, Kyoto, Japan, TH/P1-34.

[3] A. Matsuyama, M. Yagi, Y. Kagei, and N. Nakajima, Nucl. Fusion **54**, 123007 (2014).